

Gastric Motility

The motor functions of the stomach include:

1. Storage of food.
2. Mixing and partial digestion of food to form chyme.
3. Slow emptying of the chyme into the duodenum.

Anatomically, the stomach is divided into: fundus, body, antrum and pylorus.

Physiologically the stomach is divided into:

- Proximal motor unit (fundus and the proximal portion of the body), with thin wall, responsible for: storage of food (receptive relaxation).
- Distal motor unit (distal portion of the body and antrum), with thick muscle wall, responsible for:
 - Mixing and partial digestion of food to form chyme.
 - Propelling and emptying of the chyme into the duodenum.

Storage Function of the Stomach (Receptive relaxation):

- It is the function of the proximal motor unit. The volume of the contents of an empty stomach is about 50ml, and the pressure in the proximal motor unit is equal to the intra-abdominal pressure (few centimeters of water).
- The arrival of food into stomach initiates a reflex relaxation of the stomach to increase its capacity for food (It can accommodate 1-1.5 liters without rising in pressure).
- This relaxation is called **receptive relaxation**. It is vago -vagal reflex mediated by afferent and efferent vagal fibers that is initiated by gastric

distension . The neurotransmitter released from postganglionic nerve endings is VIP and is completely abolished by vagotomy.

- The relaxation is also triggered by movement of pharynx and esophagus during swallowing.

Mixing and Propulsion of Food in the Stomach:

- Gastric peristaltic contractions, initiated by gastric distension , usually begin in the middle of the body of the stomach and travel towards the pylorus.

- The contractions increase in force as they travel towards the pylorus. The contraction mix the gastric contents and periodically propel a portion of gastric contents through pylorus into duodenum . Most of the gastric contents are propelled back into stomach for further mixing and further reduction in particle size a process known as retropulsion.

- These waves of contraction are initiated by the "**Basic Electrical Rhythm**" (BER), also called "**Gastric Slow Waves**".

- They start at the midpoint of the greater curvature of the stomach (pace maker of the stomach), at a rate of 3-5 cycles/min.

- Some of the waves only lead to spike bursts, which lead to peristaltic waves. Only slow waves , which are accompanied with spike bursts are followed by the peristaltic mechanical response. . Vagal stimulation and gastrin hormone increase frequency of action potentials and the force of gastric contraction , but it can never exceed the BER..Sympathetic stimulation , Sympathetic innervation , GIP and secretin hormone decrease frequency of action potentials and the force of contractions .

Gastric emptying:

Stomach empties slowly into duodenum and complete emptying takes usually 3-4 hours after meal .

-In the regulation of gastric emptying, the antrum, pylorus and upper duodenum **function as a unit**.

-Contraction of the antrum is followed by sequential contraction of the pyloric region.

- In the antrum, partial contraction prevents solid masses from entering the duodenum and they are mixed and crushed instead. The more liquid contents are squirted a bit at a time into the small intestine through the pylorus.

-Normally, regurgitation from the duodenum does not occur because contraction of the pyloric segment tends to persist longer after the start of relaxation of duodenum.

-The prevention of regurgitation may also be due to the stimulating action of cholecystokinin (CCK) and secretin on the pyloric sphincter.

Regulation of Gastric Evacuation:

1) Gastric factors: (Nervous and hormonal):

Distension of the stomach wall, through both nervous reflexes (short and long vagal reflex) and gastrin hormone release, increases stomach emptying by increasing the pyloric pumping force.

2) Intestinal factors: (Nervous and hormonal)

a) Nervous: (Enterogastric Reflex)

The presence of the following factors in the duodenum inhibits gastric emptying

- Increased acidity.
- Irritation.

- Distension
- Hypertonicity.
- Fats and protein.

b) Hormonal:

The presence of fat in duodenum releases some GIT hormones (CCK, GIP and secretin) from duodenal mucosa. They result in inhibition of the pyloric pump and emptying, with closure of pyloric sphincter.

a. Consistency of food:

Liquid food is evacuated more rapidly than solids which need to be first liquefied in the stomach. Isotonic contents empty more rapidly than hypotonic or hypertonic contents

b. Reflexes from outside the GIT:

- Pain produces reflex inhibition of gastric motility.
- Emotions can either increase or decrease gastric motility.

Abnormality of gastric motility:

1-Hunger contractions (Hunger pains):

They are painful contractions associated with hunger and fasting. The feeding center in the hypothalamus is normally active, unless it is inhibited by impulses from the satiety centre. Hypoglycemia increases activity of the feeding centre which sends impulses to:

- Limbic cortex giving the hunger sensation.
- Vagal nucleus in the medulla, leading to hunger contractions or hunger pains.

2-Vomiting:

-It is outward expulsion of the gastric contents through the esophagus into the mouth.

-It is controlled by the vomiting center is in the medulla oblongata, and is anatomically and functionally associated with the respiratory centers.

-Vomiting is a protective mechanism, to protect the GIT against toxic or irritant substances.

Causes of vomiting:

1) Reflex:

- a) Mechanical stimulation of the posterior part of the tongue.
- b) Irritation of the gastric mucosa.
- c) Intestinal obstruction or irritation.- renal colic

2) Central

By factors which stimulate the vomiting center in the medulla oblongata. or stimulation of the chemoreceptor trigger zone which in turn stimulates vomiting centre .

- Drugs as apomorphine,.

- Toxemia.

- Motion sickness: sea and air sickness, due to labyrinthine stimulation. Stimulation of the chemoreceptor trigger zone is the cause of vomiting in early pregnancy , diabetic ketoacidosis and uremia .

Mechanism of vomiting:

It is usually preceded by nausea, sweating, salivation and tachycardia, then:

- ① Deep inspiration followed by strong contraction of the diaphragm and the abdominal muscles to increase the intra-abdominal pressure and squeeze the contents of the stomach up through a relaxed lower esophageal sphincter.

② Protection of the air passages occurs similar to that during swallowing :

- Elevation of soft palate to close the nasal cavity.
- Closure of the glottis
- apnea.

③ The stomach wall is completely passive:

- Relaxation of the wall of the stomach.
- Relaxation of the LES and UES.
- Contraction of the pyloric sphincter to close the pyloric orifice.

Complications of repeated vomiting:

1 - Dehydration: due to loss of water leading to hypotension and tachycardia.

2- Metabolic alkalosis: due to loss of HCL.

3 -Hypokalemia.